NMC
Committed to Nuclear Excellence

Kewaunee Nuclear Power Plant
N490, State Highway 42
Kewaunee, WI 54216-9511
920-388-2560

Operated by
Nuclear Management Company, LLC

NRC-02-060

July 5, 2002 10CFR 50.73

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Ladies/Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Reportable Occurrence 2002-002-00

In accordance with the requirements of 10 CFR 50.73, "Licensee Event Report System," the attached Licensee Event Report (LER) for reportable occurrence 2002-002-00 is being submitted. This report contains no new commitments.

Sincerely,

Thomas Coutu
Manager-Kewaunee Plant

GIH

Attach.

cc - INPO Records Center
US NRC Senior Resident Inspector
US NRC, Region III

IE22

NRC FORM 366 (1-2001) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 7-31-2004

Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

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TITLE (4)

Technical Specifications Required Shutdown: CCW System Leak Could Not Be Repaired Within LCO

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
05	05	2002	2002	-- 002 --	00	07	05	2002	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	N
POWER LEVEL (10)	100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply) (11)

20.2201(b)		20.2203(a)(3)(ii)		50.73(a)(2)(ii)(B)		50.73(a)(2)(ix)(A)	
20.2201(d)		20.2203(a)(4)		50.73(a)(2)(iii)		50.73(a)(2)(x)	
20.2203(a)(1)		50.36(c)(1)(i)(A)		50.73(a)(2)(iv)(A)		73.71(a)(4)	
20.2203(a)(2)(i)		50.36(c)(1)(ii)(A)		50.73(a)(2)(v)(A)		73.71(a)(5)	
20.2203(a)(2)(ii)		50.36(c)(2)		50.73(a)(2)(v)(B)		OTHER Specify in Abstract below or in NRC Form 366A	
20.2203(a)(2)(iii)		50.46(a)(3)(ii)		50.73(a)(2)(v)(C)			
20.2203(a)(2)(iv)	X	50.73(a)(2)(i)(A)		50.73(a)(2)(v)(D)			
20.2203(a)(2)(v)		50.73(a)(2)(i)(B)		50.73(a)(2)(vii)			
20.2203(a)(2)(vi)		50.73(a)(2)(i)(C)		50.73(a)(2)(viii)(A)			
20.2203(a)(3)(i)		50.73(a)(2)(ii)(A)		50.73(a)(2)(viii)(B)			

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Gary I Harrington – Compliance	(920) 388-8559

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On 5/5/02, Nuclear Management Company, LLC (NMC) determined that repairs to correct leaking tubes in the Component Cooling Water (CCW) system heat exchangers (Hxs) could not be completed within the Technical Specifications (TS) allowed outage time. Consequently, a conservative decision was made to shutdown the plant to repair the Hxs. A plant shutdown was completed at 1906 on 5/5/02 in accordance with guidance provided by TS. Leakage from the CCW system was discovered to exist through the 'A' CCW Hx to the service water (SW) system. SW is the engineered safety features (ESF) system, ultimate heat sink providing CCW cooling. Visual inspection of the Hx tubesheet area revealed a number of tubes with through-wall leaks near the tube ends. Further inspection revealed significant circumferential cracking in the tube to tubesheet hard roll transition region. Laboratory analysis of two sample tubes removed from the Hx determined the cracking was caused by stress corrosion cracking in the hard roll transition area. An extent of condition inspection of the 'B' CCW heat exchanger revealed similar cracking with no in-service detectable leakage. The Hxs were repaired by sleeving all the in-service Hx tubes. Further review of the need to replace the Hxs completely or in part is in progress. The CCW Hx leakage did not make the CCW system inoperable. Both heat exchangers remained available to perform their safety function in all probabilistic event scenarios. Except when removed from service for testing and maintenance, the Hxs remained available to provide their design function to remove heat from supported components. Since there was no failure to remove heat, there was no increase in risk as a result of this condition. The leakage of CCW water to the environment also posed no public health or safety risk. There was no radiological release consequence, and CCW release was consistent with approved release paths and flows.

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TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

DESCRIPTION

On May 5, 2002, at 1906 a preventive plant shutdown was completed in accordance with Technical Specifications (TS) Section 3.3.d.2. The decision to shutdown was a conservative decision to support repairs to leaking heat exchanger (Hx)[HX] tubes in the component cooling water (CCW)[CC] system. The repair effort could not be completed within the allowed TS outage time of 72 hours. Inspection of the CCW Hxs revealed significant circumferential cracking in a significant number of tubes [TBG] in the transition area of the tube to tubesheet hard-roll of the 'A' and 'B' train heat exchangers.

As stated in the Kewaunee Updated Safety Analysis Report (USAR) Section 9.3, the CCW system consists of two CCW pumps, two CCW heat exchangers, a CCW surge tank [TK], cooling lines to various components to be cooled, and associated piping, valves, and instrumentation (see Figure 1). CCW piping to various components is arranged in parallel flow circuits. During normal operation, the CCW pumps and heat exchangers are operated as needed to accommodate the heat removal loads. One pump and one heat exchanger can provide 100% heat removal capability during normal operation. Two pumps and two heat exchangers are used to remove the residual and sensible heat during plant shutdown. If one of the pumps or one of the heat exchangers is not operable, safe shutdown of the plant is not affected; however, the time for cooldown is extended.

On May 1, 2002, a 21 day service water (SW) system [BI] chemical treatment using sodium hypochlorite was completed for a Zebra Mussel kill. SW is the engineered safety features (ESF) system, ultimate heat sink providing CCW cooling. Subsequent to completing the chemical treatment, a flush of the system is performed by maximizing flow through the CCW heat exchangers to flush the SW system of any debris created from the treatment, primarily Zebra Mussel shells. Prior to completing the flush, the control room [NA] received a CCW annunciator [LA] for surge tank low level. No abnormal plant waste collection sump levels were identified, and a walk down of the CCW system in the auxiliary building [NF] showed no signs of leakage. Troubleshooting and various equipment isolation steps were conducted in an attempt to identify the leak location. Through elimination of other system components as potential leak locations, it was concluded that the likely source of the leak was between the CCW Hx into the SW system. On May 3, 2002, Operations performed Special Operating Procedure, SOP-CC-31-19, "CC Heat Exchanger A Leak Test." This test proved CCW Hx 'A' was the source of the leak.

The heat exchanger was opened (SW side) and numerous tubes were found to have through-wall leaks. After a close visual inspection, it was identified that the tubes had circumferential cracking in the tubesheet area. Sections of two leaking tubes were cut out and sent to a vendor for failure analysis. The conclusion from this analysis was circumferential stress corrosion cracking, which was initiated at the interior side of the tubes (SW side) at the roll transition near the tube sheets. Chlorine was found in the cracks which may have been a contributor. Sodium hypochlorite is injected to the SW system for control of biological fouling and zebra mussels.

Tubing material in the CCW Hx is Admiralty Brass, known to be susceptible to stress corrosion cracking. The Kewaunee Hx tubes have been inspected at a frequency and using a method that meets industry standards. The CCW Hxs are original plant equipment, approximately 28 years old. Eddy current testing has routinely been done using a Bobbin probe, which has difficulty detecting and characterizing circumferential cracks. In addition, the location of the cracks in the rolled transition, very close to the tubesheet, makes it difficult to detect the cracks due to interference from the tubesheet Because the past eddy current testing method did not detect circumferential cracks, it was not possible to determine when the stress corrosion cracks started. Consequently the speed at which the cracking may have been advancing is indeterminate.

Following sleeve repairs to the 'A' train Hx, the 'B' train Hx was removed from service and inspected. The 'B' Hx inspection revealed similar crack indications in the same tube to tubesheet areas. However, the 'B' Hx did not exhibit detectable leakage while in service like the 'A' Hx.

At 1253 CDT, on May 5, 2002, Nuclear Management Company (NMC) reported this condition via the emergency notification system (EN# 38900) in accordance with 10CFR50.72(b)(2)(i) as a TS required shutdown.

CAUSE OF THE EVENT

The root cause for the CCW Hx tube failure is less than adequate testing for a known, although uncommon, failure mode.

The CCW Hxs have been inspected every three years, starting in 1987, using eddy current technology. Due to tube deterioration being detected, the frequency of inspection was increased to every 1½ years in 1999. The probe used during these inspections was a Bobbin Probe and the main indication being detected was under deposit internal corrosion pitting. The last eddy current inspection of 'A' CCW Hx was performed during the last refueling outage in October, 2001. The ANATEC, INTL. inspection report, # NMC-KN1-03, dated October 16, 2001, makes no mention of circumferential cracking at the tube transition area in either 'A' or 'B' CCW Hxs. This due to the inspection technique employed and its inefficiency in detecting circumferential stress corrosion cracking, especially near the tubesheets.

The condition of the CCW Hxs, as stated in the report, prompted writing an internal corrective action request (CAP 1101) to assess the need for replacing the Kewaunee CCW heat exchangers due to age and inspections showing that the Hxs are degrading. The evaluation of this CAP concluded in January of this year that some form of repair option should be pursued with a tentative schedule for initiating repairs in 2004.

No indications of circumferential stress corrosion cracking in the transition area of the tubes were identified in any inspections prior to this event. This is presumed due to the technology employed and its inefficiency of detecting circumferential stress corrosion cracking.

ANALYSIS OF THE EVENT

This event did not result in individual or redundant trains of CCW being inoperable. Therefore, this condition is not reportable as a Safety System Functional Failure under 10CFR50.73(a)(2)(v). However, because repairs to the heat exchanger could not be completed within the TS allowed outage time, it is conservatively being reported in accordance with 10CFR50.73(a)(2)(i), the completion of a plant shutdown required by TS.

The consequences of the event from a risk and public health and safety perspective posed no concern. The condition of the CCW Hxs was that the 'A' heat exchanger was leaking. A leak rate was calculated by operating crews at approximately 0.4 gallons per minute (gpm). This was determined by calculating the amount of water necessary to return the CCW surge tank levels to normal. There was no evidence to indicate that the 'B' heat exchanger experienced the same degree of leakage as the 'A' Hx. This was evident by a stable level indication in the CCW surge tank while the 'B' heat exchanger was operating and the 'A' heat exchanger was isolated from the system for repairs.

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The calculated leak rate remained well within the capacity of the makeup system. Control Room log entries show that normal level in the surge tank could be restored within ten minutes of a low level alarm being received. Control room logs also show that the need to refill the surge tank was on the order of every 3.5 to 5 hours. Therefore, it is evident that the operating shifts were able to maintain CCW system water inventory at acceptable levels. Since the result of the CCW Hx leakage did not make the CCW System unavailable, both Hxs would have been available to perform their safety function in all probabilistic event scenarios. They would have been able to remove decay heat via the residual heat removal (RHR)[BO] system if needed, and remained fully capable of providing normal operating equipment cooling support. The plant shutdown and repairs were a preventative measure to preclude any significant degradation that could possibly hamper heat removal capability. Since there was no failure to remove decay heat, there was no increase in risk as a result of this condition.

Along with reviewing any risk potential from a plant operation and design perspective, the potential for a public health and safety risk from an inadvertent release of CCW to the environment was also assessed. The radiological risk was evaluated using the normal plant radiological release procedures. A radiological discharge permit was developed to determine the magnitude and document the release. The release data show that no discharge limits were exceeded and consequently no public health or safety radiological concern existed. Additionally, Kewaunee no longer uses a chromium based corrosion inhibitor in the CCW system. A combination of molybdate, nitrite, and tolytriazole is now being used. These chemicals are all in the sodium salt form. The release of CCW water to Lake Michigan has also been previously evaluated. Correspondence between Kewaunee and the State of Wisconsin Department of Natural Resources signify releasing CCW water to the lake as acceptable. It should also be noted that the release rates proposed to the State were at 0.7 gpm. As noted earlier, the calculated release rate was below this previously analyzed value.

CORRECTIVE ACTIONS

NMC has completed the following corrective actions:

- Evaluated the potential impact on public health and safety from the event. No concerns were revealed.
- Individually removed both CCW Hxs from service and installed sleeves in the affected area of all the open tubes in both Hxs. Sleeves were installed in all the open tubes without regard to whether the parent tube showed evidence of cracking.

NMC plans to perform the following corrective actions:

- Actions are in process to determine the appropriate repair option to restore the Hxs to optimal conditions. The tentative schedule to initiate repairs is by the next scheduled refueling outage in 2003, at least for the first of the two heat exchangers. It may not be reasonable to assume that both heat exchangers could be completed during the same outage.
- The lessons learned from this event will be considered for future inspections of plant heat exchangers.

SIMILAR EVENTS

No similar events were identified.

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Figure 1: Simplified CCW Sketch